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M3Or1C-03: Growth Mechanism and Kinetics of Nb3Sn coating in tin vapor diffusion process

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Nb3Sn is the front running alternative material to replace niobium in SRF cavities. The most promising path toward deployement appears to be the tin vapor diffusion coating of Nb cavity, which had achieved significant progress in recent years. To elucidate the growth kinetics of Nb3Sn coating during this process, niobium samples were coated for different duration up to 60 hours. Several of them were coated over multiple times. Analysis of coated samples is consistent with the model in which tin primarily diffuses down to Nb3Sn-Nb interface grain boundaries, where the growth of Nb3Sn into the niobium bulk takes place. Similar scaling laws are found for grain size growth and layer thickness of Nb3Sn. Observed non-parabolic layer growth is consistent with significant grain growth, which reduces the number of Sn transport channels. "Patchy" regions, composed of large crystalline grains are commonly seen defects in Nb3Sn, which exhibit significantly thinner coating due to impeded growth of Nb3Sn layer because of low grain boundary density.

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